Chrysis pulchellus, Cam. Mem. & Proc. Manch. Lit. & Phil. Soc. xxvi. (1887), 10.

340. CHRYSIS OCULATA, Fabricius.

Chrysis oculata, Fabr. Syst. Ent. 357, 3; Ent. Syst. ii. 239, 5; Syst. Piez. 171, 6; Dahlb. Hym. Eur. ii. 310, 176; Smith, Jour. Linn. Soc. xi. (1867), 398, 7; Mocs. Mon. Chrysid. 543, 638, ♀ ♂.
Pyria oculata, Brullé, Hym. iv. 19, 1.

341. CHRYSIS PRINCIPALIS, Smith.

Chrysis principalis, Smith, Trans. Ent. Soc. 1874, 461, 13 ♀; Mocs. Mon. Chrysid. 559, 659 ♀ ♂.

EXPLANATION OF PLATE XV.

Fig. 1. *Sphex nigripes*, Smith, p. 440.
1 *a*. „ „ front of face and clypeus.
2. *Salius rubidus*, Bingh., p. 435.
3. *Sphex tyrannica*, Smith, p. 440.
3 *a*. „ „ front of face and clypeus.
4. *Methoca nigra*, sp. nov., p. 427.
5. *Pompilus ignicolor*, sp. nov., p. 432.
6. *Crabro palitans*, sp. nov., p. 446.
7. *Salius properus*, sp. nov., p. 436.
8. *Gorytes greenii*, sp. nov., p. 444.
9. *Megachile ceylonica*, sp. nov., p. 453.

2. On British Hydroids and Medusæ. By EDWARD T. BROWNE, B.A., F.Z.S., Zoological Research Laboratory, University College, London.

[Received March 14, 1896.]

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INTRODUCTION.

These notes refer chiefly to Medusæ taken at Plymouth during September 1893, and from the middle of August to the end of September 1895, and also during April and May 1895, in Valencia Harbour, on the West Coast of Ireland.

I published, last year, a few notes on the Medusæ taken at Port Erin, Isle of Man, and have avoided in this paper, so far as possible, a repetition of those notes, but have revised the nomenclature in a few cases. I have not yet made sufficient progress with the study of our Medusæ to justify the publication of anything more than a few selected notes on the species which are best known to me.

The double system of classification, with one name for the hydroid and another for the medusa, I no longer intend to use. In cases where the hydroid form of the medusa is known I have used both the generic and specific names of the hydroids, without any alteration; but in cases where the medusa only is known I have given the generic names as used by Haeckel in his monograph, but not always his specific names. It is my intention to transfer these medusæ to their hydroid names as soon as the hydroid forms are discovered.

In some instances the free-swimming medusa has been described before the hydroid form was known, but I do not feel justified in changing the specific names of the hydroids, which are now so well known, as it would lead to a considerable amount of confusion.

The introduction of formaldehyde as a preserving fluid instead of alcohol is of great importance to the marine naturalist, especially when working in localities where it is difficult to obtain a supply of good spirit. I first tried formaldehyde for preserving marine animals at Valencia last year. The results both for hydroids and medusæ were far superior to those obtained by means of alcohol. The colour, however, is not permanently preserved. Specimens preserved in formaldehyde, even when killed with the usual reagents, are practically useless for histological work. The best results with hydroids and medusæ have been obtained when the specimen has been killed by a fixing reagent, and then placed first into a 2½ p. c. solution and finally into a 5 p. c. solution of formaldehyde.

I owe my sincere thanks to Professor Weldon for allowing me the use of a table in his Research Laboratory at University College, and for the aid and kind advice which he has so often generously given. To Mr. E. J. Allen, Director of the Marine Laboratory at Plymouth, I am indebted for his kindness in arranging expeditions for the collection of specimens during my visit to Plymouth.

PART I.—HYDROIDS AND THEIR MEDUSÆ.

(HYDROIDA GYMNOBLASTEA.)

In the first part of these notes the Medusæ come under their hydroid names, and are arranged according to Allman's classification. The synonyms are divided into two sets: the first set contains the names given to the hydroid form, and includes, also, the references to the medusa whilst attached to the hydroid, or reared from the hydroid in confinement. The second set of synonyms refers only to free-swimming medusæ taken in the sea, which have been usually described under other names.

Fam. SYNCORYNIDÆ.

GEMMARIA IMPLEXA (Alder).

Tubularia implexa, Alder (1857).
Coryne pelagica, Alder (1857).
Coryne briareus, Allman* (1859).
Coryne implexa, Wright (1859); Alder* (1861).
Zanclea implexa, Allman* (1864); Hincks* (1868).
Gemmaria implexa, Allman* (1872); Haeckel* (1879).

* References marked with an asterisk denote that medusa-buds upon the hydroid are also referred to.

Two specimens of the medusa were taken at Plymouth on Aug. 31st, 1895. Both were about 1 mm. in diameter, and corresponded to the figures given by Allman in his monograph. The hydroid form has not yet been recorded for the South of England.

The medusa of *Gemmaria implexa* is very much like a medusa described by McCrady as *Gemmaria gemmosa*, found in Charleston Harbour, U.S.A.

DISTRIBUTION. Scotland—Forfarshire, *Allman* (H[1]). Firth of Forth, *Wright* (H); *Allman* (H).

England—30 miles E. of Holy Island, *Alder* (H). Cullercoats, *Alder* (H); Seaham Harbour, *Hodge* (H); Plymouth, *E. T. B.* (M[1]).

[1] H = Hydroid form, with or without medusa-buds.
M = Free-swimming medusoid form only.

Fam. BOUGAINVILLIDÆ.

PERIGONIMUS REPENS (Wright).

Hydroid Form.

Atractylis repens, Wright* (1858); Alder* (1862).

Perigonimus repens, Hincks* (1868); Allman* (1872); Winther (1880); Duerdin (1893); Garstang* (1894).

Perigonimus minutus, Allman* (1863); Hincks* (1868); Allman* (1872).

Medusoid Form.

Perigonimus repens, Crawford (1895).

At Plymouth, on September 2nd, 1893, I placed a colony of *Perigonimus repens* in a jar of sea-water. On the following day about a dozen medusæ were budded off. On the 13th another two dozen were swimming in the jar from the same colony. None of the medusæ showed any signs of further development after their liberation from the hydroid colony.

The umbrella of the medusa is about $\frac{3}{4}$ mm. in length and width. There are two opposite perradial tentacles and two opposite perradial bulbs, without tentacles. Some of the specimens have a knob at the aboral end of the umbrella. The knob varies in size and shape in different individuals, in a few it is absent.

Mr. W. Garstang sent me a colony from Plymouth, on March 17th, 1894. On the 19th two medusæ were budded off, one with a short knob at the aboral end of the umbrella, the other without a knob. Unfortunately I was not able to keep these medusæ alive long enough to observe any further changes. Wright (1861) states that he has kept the medusa until it had four perradial tentacles and four interradial bulbs.

Allman (1863) described another hydroid, *Perigonimus minutus*, which, he states, is very much like *Perigonimus repens*. The chief difference is in the shape of the medusoid, which has a constriction across the aboral end of the umbrella. The figure given by Allman of this medusa agrees with the specimens with a conical knob, bred in my jars. Hincks (1868) has placed *Perigonimus minutus* as a synonym of *Perigonimus repens*; but Allman (1872) has again separated them into two distinct species. As I have obtained from the same colony medusæ similar to Wright's figures of *Perigonimus repens* and to Allman's figures of *Perigonimus minutus*, I do not now see any reason for their separation into two distinct species.

DISTRIBUTION. Denmark, Baltic Sea, *Winther* (H). Heligoland, *Hartlaub* (H).

Scotland—Shetland Islands, *Allman* (H). St. Andrews, *Crawford* (M). Firth of Forth, *Wright* (H).

England—Cullercoats (Northumberland), *Alder* (H). Plymouth, *Garstang and E. T. B.* (H). Ilfracombe, *Hincks* (H).

Ireland—S.W. Coast, *Duerdin* (H).

Fam. PODOCORYNIDÆ.

PODOCORYNE CARNEA, Sars.

Hydroid Form.

Podocoryne carnea, Sars* (1846); Hincks* (1868); Allman* (1872); Duerdin (1893); Garstang* (1894).

Podocoryne albida, Sars (1846).

Medusoid Form.

Podocoryne carnea, Crawford (1895).

Dysmorphosa carnea, Haeckel (1879); Browne (1895).

Lizzia blondina, Böhm (1878).

Sars first described both the hydroid and medusoid forms of *Podocoryne carnea*. Haeckel has, however, given the name *Dysmorphosa carnea* to the medusa. The medusa of *Podocoryne carnea* must not be confused with *Dysmorphosa minima*, Haeckel, which I believe to be the earliest stage of *Lizzia blondina*, Forbes. The latter has its stomach upon a peduncle, and medusa-buds are usually present upon the walls of the stomach in the early stages.

At Plymouth, in September 1893, and again in 1895, I tried to rear the young medusæ budded off from the hydroid colonies kept in glass jars. The experiments did not yield any results, as the medusæ died off within a week.

The young medusæ do not all leave the hydroid colony with the same number of tentacles. All have four single perradial tentacles, but the number of interradial tentacles shows variation. The usual number is either two or three, but I have seen a specimen with only one tentacle. The interradial tentacles do not appear in any definite order. In some specimens the two interradial tentacles are opposite one another, in others they occupy adjacent quadrants of the umbrella.

I have not seen a specimen with eight tentacles amongst those reared in my jars, but have taken specimens in the tow-net.

At Valencia, on April 10th, 1895, I took a specimen of the medusa with eight tentacles.

DISTRIBUTION. Norway, *Sars* (H). Naples, *Sars* (H).

Scotland—St. Andrews, *M'Intosh* (M); *Crawford* (M). Firth of Forth, *Allman* (H).

England—Plymouth, *Garstang and E. T. B.* (H, M). Isle of Man, *Browne* (M).

Ireland—Long Island Bay, *Duerdin* (H). Valencia Island, *E. T. B.* (M).

Fam. CORYMORPHIDÆ.

CORYMORPHA NUTANS, M. Sars. (Plate XVI. fig. 1.)

Hydroid Form.

Corymorpha nutans, M. Sars* (1835); Forbes and Goodsir (1840); Johnston (1847); Sars* (1859); Hodge* (1861); Allman* (1863) (1864); Hincks* (1868); Allman* (1872);

Sars * (1877); Haeckel (1879); [medusa = *Hybocodon nutans*] Haddon (1885); Hincks (1886); Hartlaub (1894); Allen * (1895).
Corymorpha galanthus, Haeckel (1879).

Medusoid Form.

Corymorpha nutans, Allman (1863); Garstang (1894); Crawford (1895).
Steenstrupia rubra, Forbes (1848); Peach (1849); Haddon (1885); Browne (1895).
Steenstrupia flaveola, Forbes (1848).
Steenstrupia galanthus, Haeckel (1879); Hartlaub (1894).

The hydroid form of *Corymorpha nutans* with medusa-buds was first described by Sars from specimens taken on the Norwegian coast. Forbes and Goodsir a few years later added the hydroid to the British list by finding specimens off the Orkney Islands. Hodge has described specimens from Seaham Harbour and Allman from the Firth of Forth.

Allman, Hincks, Hodge, and Johnson consider the British species to be that described by Sars, and call it *Corymorpha nutans*.

Haeckel, however, states that the Norwegian species is quite distinct from the British species. He retains the name *Corymorpha nutans* for the Norwegian hydroid and calls the medusoid *Hybocodon nutans*. The English species has been given the new name of *Corymorpha galanthus* and its medusoid called *Steenstrupia galanthus*; under the latter name Haeckel places the medusoid *Steenstrupia rubra*, Forbes, as a synonym.

This separation is entirely based upon the shape of the umbrella of the medusa. Sars described the young medusa upon the hydroid as having an oblique margin to the umbrella, like *Hybocodon prolifer*. This has led Haeckel to place the medusa in the genus *Hybocodon*.

Haeckel apparently, judging from his references, has only read the description of the English species in the monographs by Hincks and Allman. In these, the margin of the umbrella is described and figured as occupying its normal position at right angles to the longitudinal axis of the umbrella, and no mention is made of the obliqueness of the margin of the umbrella of the medusa whilst attached to the hydroid. But in the original papers published by Hodge (1861) and by Allman (1863) on the hydroid *Corymorpha*, the medusa is described with an oblique margin to the umbrella; it therefore corresponds with the description given by Sars. Hodge gives figures of the medusæ upon the hydroid, and the margin is shown to be distinctly oblique. He not only figures the medusæ upon the hydroid but gives an excellent figure of the free-swimming form, just liberated from the hydroid kept in his aquarium. The free-swimming medusa, as figured by Hodge, has the margin at right angles to the longitudinal axis of the umbrella; therefore it cannot be oblique. Allman (1863), in his original description of *Corymorpha*, on the development of the medusa states :—" The four peripheral processes continue to elongate and are soon seen to be dilated into bulb-like expansions at their extremities. The bulbs increase in size and come in contact by their sides; while one of them, enlarging much more rapidly than the other three, gives a marked preponderance to its side of the bud and makes the distal end of the bud appear obliquely truncated. It then begins to extend itself beyond this distal end into a thick hollow tentacle."

Allman also obtained free-swimming medusæ from his hydroids, which he has described and figured in his monograph. These are similar to the figures given by Hodge, and have a margin at right angles to the longitudinal axis of the umbrella.

From the description given by Allman of the development of the medusa, it appears that the rapid growth of the large tentacle-bulb extends the length of the umbrella more on that side than on the other, and in this way the margin becomes oblique, as one side of the umbrella is longer than the other. It is clear from the descriptions given by Hodge and Allman, that the obliqueness must disappear before the medusa is liberated, as they figure the free-swimming form with the margin in the normal position. I think that these observations on the obliqueness of the margin of the umbrella strengthen the view that the British and Norwegian specimens belong to the same species, and I have again united them under the old name of *Corymorpha nutans*.

Forbes has given only two species in his medusoïd genus *Steenstrupia*, namely *S. rubra* and *S. flaveola*. I agree with Haeckel in considering that these are not distinct species. The characteristic features of these medusæ are similar to those of the medusæ of *Corymorpha nutans*. The figures given by Forbes of *Steenstrupia* show the characteristic points of the species, but they are not good figures of a healthy specimen of the medusa of *Corymorpha*.

Hodge recognized the similarity between *Steenstrupia* and the medusa of *Corymorpha*, but was led by Forbes's figures to consider the latter as another species.

Allman states the medusa of *Corymorpha* "belongs to a form to which Forbes has given the generic name of *Steenstrupia*." Sars (1877) writes, "It is even not improbable that when disconnected from the parent animal, they (the medusæ) may develop themselves into the species described by Forbes under the name of *Steenstrupia rubra*."

During my visit to Valencia Island in 1895, I found medusæ corresponding to the descriptions and figures given by Hodge and Allman of the medusa of *Corymorpha nutans* (Pl. XVI. fig. 1). They were often exceedingly abundant during April and May, and some occasions many hundreds could have been quickly collected. One day I thought that a lovely Siphonophore had entered the net, but closer examination showed some dozens of these medusæ, caught by the tentacle, on a piece of cotton about an inch and a half long.

The umbrella is bell-shaped, nearly twice as long as wide; the aboral end of the umbrella is extended into a spine-like process, which is always present, and is a characteristic feature of the medusa. By this it may be distinguished from another uni-tentacular medusa—*Euphysa aurata*.

The aboral end of the umbrella varies in shape. In some specimens it is round, and the process is conspicuous by its spine-like appearance; in others there is a gradual slope from the side of the umbrella to the apex of the umbrella, forming a cone-shaped summit. The manubrium is about two-thirds the length of the umbrella-cavity; occasionally, when fully expanded, it may reach a little way beyond the margin. The mouth is round, without lips. The stomach is attached to a short peduncle. From the base of the stomach an apical stalk is always present and runs up into the spine-like process of the umbrella. On the margin of the umbrella there is only one large perradial tentacle, ringed with nematocysts, and when fully expanded is about four times the length of the umbrella. Three other perradial bulbs, long and narrow, without tentacles, curl over the margin of the umbrella.

The colour of the medusa shows little variation: the tentacle, bulbs, and stomach are usually of a light pinkish colour, but sometimes reddish brown. In some of the largest specimens the extreme apex of the spine-like process may be slightly tinged with a pinkish colour. The size of the umbrella varies according to age; the youngest specimens taken in the net measured about 1 mm. in length, the umbrella of the largest measured 6 mm. Many were taken about 5 mm. in length and 3 mm. in width.

DISTRIBUTION. Norway, *Sars* (H). Heligoland, *Hartlaub* (H, M); *Haeckel* (M).

Scotland—Orkney Islands, *Forbes & Goodsir* (H). Shetland Islands, *Allman* (H); *Forbes* (M). St. Andrews, *Crawford* (M). Firth of Forth, *Allman* (H, M).

England—Seaham Harbour, *Hodge* (H). Plymouth, *Heape* (H); *Allen* (H, M); *Garstang* (M). Fowey, *Alder* (H); *Peach* (M). Penzance, *Forbes* (M). Mersey Estuary, *Hincks* (H). Isle of Man, *Alder* (H); *Browne* (M).

Ireland—Kingstown, *Haddon* (H, M). Valencia Island, *E. T. B.* (M).

Fam. HYBOCODONIDÆ.

HYBOCODON PROLIFER, Agassiz.

Hydroid Form.

Hybocodon prolifer, Agassiz * (1862); Allman * (1872).

Corymorpha prolifer, Haeckel (1879) [Medusa = *Hybocodon prolifer*].

Medusoid Form.

Hybocodon prolifer, Böhm (1878); Crawford (1895).
Coryne (Corymorpha) fritillaria, Steenstrup (1842).
Diplonema islandica, Greene (1857).
Steenstrupia owenii, Greene (1857).
Steenstrupia globosa, Sars, M. (1859); Sars (1877).
Amphicodon fritillaria, Haeckel (1879); Browne (1895).

Amphicodon globosus, Haeckel (1879).

Amphicodon amphipleurus, Haeckel (1879); Garstang (1894); Allen (1895).

The different stages in development of this medusa having been taken in localities far apart, and the wrong hydroid form assigned to one of them, has led to six distinct species being recorded. Haeckel retains four of these and places two amongst the synonyms.

I have recently given an account of this interesting medusa in the Report on the Medusæ of the Isle of Man, and here only give a summary with some additional notes on the occurrence of the medusa at Plymouth and Valencia Island.

The great abundance of this medusa at Port Erin during 1893 and 1894 enabled me to identify the early stages as species already described.

The first stage has only one tentacle, to which belongs *Steenstrupia* (*Amphicodon*) *globosa*, Sars, but only those specimens described with one tentacle.

The second stage has a single group of two tentacles, to which belongs *Coryne* (*Amphicodon*) *fritillaria*, Steenstrup.

The third stage (adult) has a single group of three tentacles, to which belong certain specimens of *Steenstrupia* (*Amphicodon*) *globosa* with three tentacles and *Amphicodon amphipleurus*, Haeckel.

The medusa first reproduces by means of numerous buds at the base of the tentacles, and when gemmation is about to cease ova or spermatozoa appear upon the walls of the stomach. The sexes are separate, and the ovum finally develops into a *Corymorpha*-like hydroid. The development takes place inside the umbrella-cavity, and the hydra remains attached to the wall of the stomach until two verticils of tentacles are formed. Steenstrup described the medusoid *Coryne fritillaria* from free-swimming specimens, and also dredged a hydroid having a single verticil of tentacles, and medusæ attached to it, without tentacles, but with an oblique margin to the umbrella—one of the characteristic features of the free-swimming medusæ. He naturally considered this hydroid to belong to the medusoid *Coryne fritillaria*. It is clear, however, from the development of the hydroid within the umbrella-cavity, that the hydroid must have two verticils of tentacles.

The hydroid has not yet been taken in the British area, but it is evident from the distribution of the medusoid form that it must exist in more than one locality. It may be difficult to recognize the hydroid form without its medusa-buds; but with medusæ, the presence of the five longitudinal bands of nematocysts upon the ex-umbrella of the medusa ought at once to establish its identity and to distinguish it from *Corymorpha nutans*.

Valencia.—On the first day of tow-netting, April 5th, a single specimen was taken, and about two dozen more during the next few days, but not one was seen after April 16th. The specimens were similar to those taken at Port Erin. Some had ova upon the wall of the stomach; others had young hydræ either attached to the stomach or free within the umbrella-cavity.

Plymouth.—Garstang (1894) has recorded this medusa for Plymouth. It was taken on a few occasions during April 1894.

Mr. E. J. Allen kindly sent me five specimens alive, on March 19th, 1895.

Two possessed a single tentacle and three had two tentacles. Medusa-buds were present at the base of the tentacles in some of the specimens. The five specimens showed a great variation in colour: one had the endoderm of both tentacles of a pinkish colour; two specimens had the mouth, tentacle-bulbs, and medusa-buds of a brilliant crimson colour, and another specimen with the same parts coloured reddish orange. One specimen showed the mouth and tentacle-bulbs of a crimson colour and the medusa-buds colourless.

DISTRIBUTION :—

Hydroid Form.

North America, Massachusetts Bay, *Agassiz.*

Medusoid Form.

Iceland, *Steenstrup.* Norway, *Sars.* Heligoland, *Böhm.* France, Granville, *Haeckel.*

Scotland—St. Andrews, *Crawford.*

England—Plymouth, *Garstang and Allen.* Isle of Man, *Browne.*

Ireland—Dublin Coast, *Greene.* Valencia Island, *E. T. B.*

Fam. HYDROLARIDÆ.

LAR SABELLARUM, *Gosse.* (Plate XVI. figs. 3, 4.)

Hydroid form.

Lar sabellarum, Gosse (1857); Hincks * (1872); Allman (1872).

Medusoid Form.

Willsia stellata, Forbes (1848); Cocks (1849); Peach (1849); Gosse (1853).

Willia stellata, Agassiz (1862); Haeckel (1879); M'Intosh (1890); Garstang (1894).

The remarkable hydroid *Lar sabellarum* was first described by Gosse (1857) from a colony, found growing upon the tube of a *Sabella*, in an aquarium. The odd appearance of the hydroid and the absence of gonophores justified Allman's statement, "We are almost tempted to regard it as an abnormal condition of some other form." Fifteen years after its first appearance in Gosse's aquarium another colony was dredged by Hincks at Ilfracombe. Hincks (1872) not only confirms the description given by Gosse, but describes the reproduction in the following words:—

"The fertile polypites of *Lar* are distributed along the creeping stolon, amongst the alimentary zooids, and bear a strong general resemblance to those of *Hydractinia.* They are slender, somewhat filiform bodies, destitute of tentacula, and terminated at the free extremity by a globular enlargement, in which many thread-cells are imbedded; they are generally inferior in size to the alimentary polypites. The reproductive buds are borne in clusters of three or four on the upper portion of the body, and when matured detach themselves as free medusiform zooids (planoblasts); they are destitute of an ectothecal covering, and are therefore freely exposed to the surrounding water. In an early stage of development the buds are much elongated, and take on their hemispherical form as they approach maturity. The planoblast, at the time of its liberation, is almost hemispherical in form; the umbrella is perfctly colourless and destitute of thread-cells. The digestive sac or manubrium is very mutable in shape; normally it is subcylindrical, and somewhat swollen at the base, with a slightly lobate mouth. Six radiating canals traverse the umbrella, terminating on the margin in as many oval bulbs of a brownish colour, from which six smooth tentacles originate. Both ocelli and lithocysts are wanting; but halfway between every two tentacles a minute sac occurs on the margin of the umbrella, containing two or three glittering bodies, which appear to be thread-cells. The planoblast, when detached, bears with it a portion of the peduncle which had formed the bond of connexion between it and the parent stock; this survives as a somewhat conical process above the base of the manubrium, but it is no doubt absorbed after a time. Six is an unusual number for the radiating canals; amongst the British Hydroida it is met with only in *Clavatella* (which has also occasionally four) and in the genus *Willsia* of Forbes."

I have every reason for believing that the young medusa of *Lar* is the first stage in the development of the medusa which has been described by Forbes as *Willsia stellata*.

At Plymouth in September 1893 the medusoid *Willia stellata* was fairly abundant, and sufficient specimens were obtained to trace its connexion with a medusa which exactly corresponds to the description and figures given by Hincks of the medusa of *Lar sabellarum*. During April and May, 1895, I again met with *Willia stellata* in Valencia Harbour, Ireland, and was able to confirm the observations made at Plymouth.

Forbes first discovered *Willsia stellata* at Oban in 1845, and dedicated the genus to Dr. Will of Erlangen. Agassiz changed the spelling to *Willia*.

Forbes has described the adult form of medusa. The early forms of it may be naturally divided into three distinct stages, according to the number of tentacles:—

First Stage. Six uniform tentacles. (Plate XVI. fig. 3.)—Umbrella, about one millimetre in length and width, varying slightly in shape but usually subhemispherical, with a broad velum. The manubrium reaches about halfway down the umbrella-cavity. In some specimens taken at Valencia the apical stalk ("Stielcanal" of Haeckel), which connected the medusa to the hydroid, was still visible in the mesoglœa of the umbrella, running from the base of the stomach nearly to the ex-umbrella. In most specimens the apical stalk had disappeared.

The stomach is on a very short peduncle, and has six short prolongations or lobes from which the radial canals start. The mouth is variable in shape, being either round or with four to six lips. Six radial canals run from the lobes of the stomach direct to the ring-canal without giving off any branches. Six tentacles, equal in size, on the margin of the umbrella, one opposite the termination of each radial canal. The basal bulb of each tentacle is large and conspicuous, containing dark brown or blackish pigments. Midway between every two tentacles a small cluster of nematocysts is situated on the ex-umbrella just above the margin.

This stage corresponds to the description given by Hincks of the medusa of *Lar sabellarum*.

Second Stage. Twelve uniform tentacles.—The commencement of the second stage is indicated by the growth of six small bulbs on the margin of the umbrella, midway between the primary tentacles. From each of these bulbs a tentacle grows until it resembles in size the tentacles belonging to the first stage. A bulb on its first appearance is of a yellowish-brown colour, but when fully grown it becomes dark brown or black. As soon as a bulb makes its appearance on the margin of the umbrella, a branch is given off from the radial canal and joins the ring-canal opposite the bulb.

The branch is always given off from the same side of each radial canal, and leaves the canal about the middle of its course on the side of the umbrella. The six lobes of the stomach have now become more conspicuous and extend over the upper part of the sub-umbrella. It is on the sides of these lobes that the reproductive cells develop. The clusters of nematocysts belonging to the first stage still remain, and twelve new clusters appear close to the margin, one midway between every two tentacles. Medusæ belonging to the second stage are about 2 mm. in diameter.

Third Stage. Eighteen uniform tentacles. (Plate XVI. fig. 4).—This stage commences with the growth of another set of six bulbs, which develop tentacles in the same manner as in the previous stage.

The new bulbs are not on the same side of the main radial canals as those belonging to the second stage, but on the opposite side. A new branch leaves each radial canal nearly opposite the junction of the first branch and runs down to the bulb on the ring-canal. In this stage each radial canal has two branch canals, one on each side of it, the whole forming a kind of three-pronged fork, with a tentacle at the end of each canal. At this stage the reproductive cells are clearly visible, and are situated along the six lobes of the stomach and arch over the top of the sub-umbrella, forming a star-like pattern of a yellowish-brown colour, hence Forbes's specific name of the medusa.

The clusters of nematocysts belonging to the first stage, and probably some belonging to the second stage, have now disappeared, and a new cluster is developed midway between every pair of tentacles. The clusters of nematocysts form an excellent mark for measuring in length the growth of the umbrella. Each series arises either on or very close to the margin, and as the umbrella grows in length so does the distance increase between the margin and each series.

If all the clusters were present, they would form, at the adult stage, four rows, one above the other—the uppermost set, with six clusters, representing the first stage, and the lowest, with twenty-four, belonging to the adult stage.

Forbes does not mention the clusters of nematocysts in his description of the species. Gosse has again described the adult, and states that five or six clusters are usually present. He gives a figure of a cluster, and of a nematocyst which has discharged its thread.

Adult Stage. Twenty-four uniform tentacles.—The addition of a fourth set of six tentacles brings the young medusa to its adult stage. The new tentacles develop just like the previous ones, and each one occupies a position midway between the tentacles belonging to the first and third stages. I have only seen one specimen which shows the connexion between the third stage and the adult form. In this specimen the third branch does not leave the main radial canal like the first two branches, but is given off from the second branch (the branch developed in the third stage) and runs down between the main radial canal and its second branch to the ring-canal, opposite the new bulb. The subsequent growth of the umbrella so separates the branches as to give the appearance of each canal dividing, about the middle of its course, into four branches, each branch running to one of the tentacles placed about equal distances apart on the margin of the umbrella.

The characteristic features of the different stages may be stated thus:—

First Stage.—6 tentacles; 6 unbranched radial canals; 6 clusters of nematocysts.
Second Stage.—12 tentacles; 1 branch to each canal; 12 clusters of nematocysts.
Third Stage.—18 tentacles; 2 opposite branches to each canal; 18 clusters of nematocysts.
Adult.—24 tentacles; 3 branches to each canal; 24 clusters of nematocysts.

Each set of tentacles usually appears about the same time and some grow faster than others. Forbes states that some of his specimens possessed only twenty tentacles.

Abnormal Forms.—First Stage. One specimen with seven radial canals, tentacles and clusters of nematocysts. Valencia, 1895.

Second Stage. One specimen with seven radial canals, each with one branch; fourteen tentacles and fourteen clusters of nematocysts. Plymouth, 1893.

It is clear beyond all doubt that the hydroid *Lar sabellarum* belongs to the Gymnoblastic group of Hydroids. The Medusoid *Willia stellata* has been always considered a Leptomedusa and was placed by Haeckel among the Cannotidæ. As I did not know of any clearly proved case of a gymnoblastic hydroid having a medusa which must be classified with the Leptomedusæ, I examined by means of sections the exact positions of the gonads. It is one of the characteristic features of the Anthomedusæ to have the reproductive cells on the wall of the stomach, and of the Leptomedusæ to have the reproductive cells upon the radial canals.

When I first saw *Willia* I certainly regarded it as a Leptomedusa. At the base of the stomach six broad canals are given off; these run along a short peduncle and over the top of the sub-umbrella; along this portion the gonads are situated; at the point where the gonads terminate the canals suddenly decrease in diameter and become somewhat inconspicuous. The question arose whether to consider the broad part of the canal upon which the gonads are situated as a prolongation of the stomach or as a part of the radial canal itself. To determine this point, I cut several series of sections of medusæ belonging to the second and third stages. All the sections clearly show that the endoderm-cells of the stomach are continued, without any change in size or shape, along the whole length of that portion of the canal upon which the gonads are situated. At the point where reproductive cells terminate the canal suddenly decreases in diameter, and the endoderm-cells become very small and flat. I think that portion of the canal upon which the gonads are situated may reasonably be regarded as a prolongation or lobe of the stomach, and that the true radial canal commences at the end of this lobe.

The sections also show reproductive cells at the base of the stomach itself, before it branches into the six lobes.

I think this medusa is as interesting as the hydroid is remarkable. It shows a kind of transitional stage between the Anthomedusæ and Leptomedusæ. The continuation of the endoderm-cells, without change, into the lobes, and also the continuation of the reproductive cells from the base of the stomach itself along the lobes, strongly point to *Willia* belonging to Anthomedusæ, and not to the Leptomedusæ.

DISTRIBUTION:—

Hydroid Form.

England—Ilfracombe, *Hincks* *.

Medusoid Form.

Scotland—St. Andrews, *M'Intosh*. Oban, *Forbes*.

England—Plymouth, *Garstang and E. T. B.* Fowey, *Peach*. Falmouth, *Cocks*. Penzance, *Forbes*. Ilfracombe, *Gosse*.

Ireland—Valencia Island, *E. T. B.*

PART II.—MEDUSÆ WITHOUT OR WITH UNKNOWN HYDROID FORMS.

These Medusæ are arranged according to Haeckel's 'System der Medusen.'

ANTHOMEDUSÆ.

Fam. CODONIDÆ.

DIPURENA HALTERATA (Forbes).

Slabberia halterata, Forbes (1848); Cocks (1849).
Dipurena halterata, Haeckel (1879); Browne (1895).

I have occasionally met with one or two specimens of this interesting medusa.

I saw one specimen at Plymouth on 25th September, 1893. The specimen was unfortunately in a bad condition, the umbrella being turned inside out. The basal bulbs of the tentacles were of a dark brown colour with a single deep crimson ocellus. At the free end of each of the four tentacles there was a very large knob-like cluster of nematocysts, and the upper half contained a dark brown pigment.

A single specimen was taken at Valencia on 10th April, 1895. Umbrella about 1 mm. in length.

Forbes describes and figures the gonads as slight swellings upon the radial canals. This statement requires confirmation. Haeckel, however, has taken a specimen at Jersey, which corresponded to Forbes's description, except that the gonads were upon the manubrium. Haeckel describes three swellings on the manubrium, one above the other, filled with sperm, the lowest swelling reaching nearly down to the mouth.

DISTRIBUTION. Jersey, *Haeckel*.

England—Plymouth, *E. T. B.* Falmouth, *Cocks*. Mounts Bay, *Forbes*. Isle of Man, *Browne*.

Ireland—Valencia Island, *E. T. B.*

DIPURENA, sp.? (Plate XVI. fig. 2.)

During my visit to Plymouth in September, 1895, I obtained upon the 10th two specimens of a medusa which certainly belongs to the genus *Dipurena*. I regard them as early stages on account of medusa-buds being present upon the stomach. I have already shown in the cases of *Amphicodon fritillaria*, *Margellium octopunctatum*, and *Lizzia blondina*, that it is a characteristic feature of the young stages to bud off medusæ, and in the adult stage to have gonads upon the stomach. I believe that *Codonium gemmiferum* and *Sarsia prolifera*, now regarded as distinct species, will be ultimately proved to be only early stages of other known species.

I have not yet been able to trace these early stages of *Dipurena* to any known species, as none belonging to the genus have been described with medusa-buds.

The specimens were very much alike, but one was twice as large as the other. The umbrella of largest specimen about 1 mm. in diameter, globular, about as long as wide; at the aboral end there is a slight rounded swelling, formed by a mass of mesoglœa. The manubrium reaches nearly down to the velum; stomach large and situated upon a stout peduncle, nearly as long as the stomach; mouth round, not divided into lips. Four medusa-buds upon the stomach (one bud nearly fully developed, the four tentacles visible with brownish basal bulbs). On the margin of the umbrella four tentacles, when fully expanded about twice the length of umbrella, with blackish basal bulbs. At the free end of each tentacle a very large brownish bulb containing nematocysts. Nematocysts are also scattered along the whole length of each tentacle. Cells are present on the peduncle which may be nematocysts. The margin of the umbrella between the tentacles is nearly straight, giving a quadrangular appearance, with a tentacle at each corner. Velum broad.

EUPHYSA AURATA, Forbes.

Euphysa aurata, Forbes (1848); Haeckel (1879); Holt (1891); Crawford (1891); Maas (1893); Browne (1895).
Euphysa mediterranea, Haeckel (1879).

Up to the present time this medusa has not been recorded from many localities. It had only been found in the northern portion of the British area until this spring, when I found it at Valencia. In the 'Report on the Medusæ of the Isle of Man' I have given a description of several specimens, and have shown that a great variation in colour occurs in some specimens, and that *Euphysa mediterranea* is only a brilliantly coloured form of *Euphysa aurata*.

At Valencia this medusa was first taken on April 16th, 1895, and after this date it was often seen in the tow-net, especially towards the end of May, when it became more abundant. Most of the specimens belonged to the early stages, and were much smaller than any taken at Port Erin.

The smallest specimens were about ¾ mm. in length, and the average-sized ones about 1–1½ mm. in length.

The shape of the umbrella, of the tentacle-bulbs, and of the large tentacle is similar in all the stages: thus there is no difficulty in identifying the earliest forms. The smallest specimens usually possess very little colour, a few are quite colourless, generally the tentacle-bulbs have a pale yellowish tint, but in a few specimens a bright yellowish colour existed.

The specimens 2–3 mm. in length possessed more colour. One specimen 3 mm. in length had yellowish tentacle-bulbs, with a deep orange-coloured centre.

Many of the early naturalists described the pigmented basal bulbs as ocelli. I prefer to retain the term 'ocellus' for definite eye-spots, as clearly seen in *Sarsia*, which also has pigmented basal bulbs.

Haeckel gives *Corymorpha nana*, Alder, as the hydroid belonging to *Euphysa aurata*. I am still of the opinion that this is not the right hydroid, as the medusæ are quite distinct.

DISTRIBUTION. Mediterranean, *Haeckel*. Atlantic, about 50 miles N.W. of Scotland, *Maas*.

Scotland—Shetland Islands, *Forbes*. St. Andrews, *Holt*; *Crawford*.

England—Isle of Man, *Browne*.

Ireland—Valencia Island, *E. T. B.*

Fam. TIARIDÆ.

AMPHINEMA DINEMA (Péron et Lesueur).

Oceania dinema, Péron et Lesueur (1809); Eschscholtz (1829).
Dianæa diadema, Lamarck (1817).
Campanella dinema, Blainville (1834).
Saphenia dinema, Forbes (1848); Peach (1849); Cocks (1849).
Saphenia titania, Gosse (1853).
Stomotoca dinema, Agassiz (1862).
Amphinema titania, Haeckel (1879); Garstang (1894).

At Plymouth I found this species fairly abundant during September 1893. Many of the specimens which I took were immature, about 1 mm. in length. One specimen measured 3 mm. in length and 2 mm. in width. The tentacles of this medusa are able to expand to a great length, often to ten times the length of the umbrella. The larger specimens have about two dozen minute marginal bulbs. Stomach yellowish brown. The base of the tentacles is of a crimson or purplish colour.

I again took a few specimens at Plymouth during September, 1895, but not so many as in 1893.

DISTRIBUTION. Scotland—Shetland Islands, *Forbes*.

England—Portland, *Forbes*. Plymouth, *Garstang*; *E. T. B.* Cornwall, *Forbes*. Fowey, *Peach*. Falmouth, *Cocks*. Ilfracombe, *Gosse*.

Fam. MARGELLIDÆ.

LIZZIA BLONDINA, Forbes.

Lizzia blondina, Forbes (1848); Peach (1849); Haeckel (1879); McIntosh (1890); Vallentin (1893); Browne (1895).
Lizzia claparedei, Claparède (1860); Haeckel (1879).
Dysmorphosa minima, Haeckel (1879); Browne (1895).

The specimens taken at Plymouth in 1893 and 1895, and at Valencia in 1895, clearly show that the earliest stage is similar to the medusa described by Haeckel as *Dysmorphosa minima*. The chief difference between *Dysmorphosa minima* and *Lizzia blondina* exists in the number of tentacles, which increase in number during the growth of the medusa.

Dysmorphosa minima has four single perradial tentacles and four single interradial tentacles.

Lizzia blondina has, in the adult stage, four perradial groups of three tentacles and four single interradial tentacles. The increase of new tentacles is shown in the following list.

Specimens collected by Mr. Garstang at Plymouth during July and August, 1893:—

$$\begin{array}{ll}\text{Perradial tentacles....} & 1111 \\ \text{Interradial tentacles ..} & \overline{1111}\end{array}\ \text{(9 specimens).}$$

$$\begin{array}{lllll}\text{Perradial ....} & 1112 & 2211 & 2121 & 2222 \\ \text{Interradial ..} & \overline{1111}, & \overline{1111}, & \overline{1111}, & \overline{1111}.\end{array}$$

On my arrival at Plymouth at the end of August, 1895, I found *Lizzia* fairly abundant in the tow-net, but no specimens were taken after the second week in September.

The following list drawn up from these specimens shows the increase of the tentacles:—

$$\begin{array}{lllllll}\text{Perradial....} & 1112 & 2121 & 2221 & 2222 & 2223 & 3332 \\ \text{Interradial ..} & \overline{1111}, & \overline{1111}, & \overline{1111}, & \overline{1111}, & \overline{1111}, & \overline{1111}.\end{array}$$

At Valencia, 1895, *Lizzia* appeared in the tow-net a few days before my departure at the beginning of June. I only obtained a few specimens, which possessed the following number of tentacles:—

$$\begin{array}{llll}\text{Perradial....} & 2222 & 2223 & 3333 \\ \text{Interradial ..} & \overline{1111}, & \overline{1111}, & \overline{1111}.\end{array}$$

The umbrella of the earliest stage is about 1 mm. in length and nearly as wide, with a slight transverse constriction above the sub-umbrella. The largest specimens are about 1½ mm. in length. Nearly every specimen belonging to the early stage has medusa-buds upon the stomach. One of the largest specimens taken at Plymouth had a mass of ova surrounding the walls of the stomach. The budding of medusæ is followed by sexual reproduction, just as in many other medusæ.

There are always four simple oral tentacles, each terminating in a large cluster of nematocysts. I have never seen more than one cluster of nematocysts upon each oral tentacle, and always four single interradial tentacles. These points distinguish *Lizzia blondina* from *Margellium octopunctatum.*

Abnormal Specimen.—An abnormal specimen was taken at Plymouth on 31st August, 1895, with 3 radial canals, 3 oral tentacles, 3 groups of perradial tentacles, with 2 tentacles in each, and 3 single interradial tentacles.

Claparède described and figured a form of *Lizzia*, which Haeckel has regarded as a distinct species and has placed it in his monograph under the name of *Lizzia claparedei.* The medusa has four perradial groups of two tentacles, and four single interradial tentacles; four simple oral tentacles, each terminating in a cluster of nematocysts. Ova upon the walls of stomach. The shape of the umbrella resembles that of *Lizzia blondina.*

Claparède discovered it off Arran Island, in the Firth of Clyde, during September 1859.

I do not think that Claparède's medusa is a distinct species, but a stage in the development of *Lizzia blondina*.

DISTRIBUTION. Heligoland, *Haeckel*.

Scotland—Shetland Islands, *Forbes*. Bell Rock (East coast), *M'Intosh*. Arran Island, *Claparède*.

England—Plymouth, *E. T. B.* Fowey, *Peach*. Falmouth, *Vallentin*. Isle of Man, *Browne*.

Ireland—Valencia Island, *E. T. B.*

MARGELLIUM OCTOPUNCTATUM (Sars).

Cytæis octopunctata, Sars (1836) (1846).

Lizzia octopunctata, Forbes (1848); Peach (1849); Agassiz (1862); Böhm (1878); Clubb (1886); M'Intosh (1890); Vallentin (1893).

Lizzia grata, Agassiz (1865).

Rathkea octopunctata, Haeckel (1879); Giard (1888); Garstang (1894); Allen (1895).

Margellium octopunctatum, Haeckel (1879); Browne (1895).

Margellium gratum, Haeckel (1879).

The medusa first reproduces itself by means of buds upon the stomach, and when it reaches the adult condition either ova or spermatozoa appear upon the wall of the stomach; the sexes being separate. What becomes of the ova after leaving the medusa is at present unknown. The ovum may give rise to a hydroid form or develop directly into a medusa. The young medusæ on leaving their parent have not always the same number of tentacles. There are usually three tentacles in each of the four perradial groups, but occasionally only two; the interradial groups may have either two or three tentacles, rarely only one. As the medusa grows the perradial tentacles increase to five in each group, and the interradial tentacles to three in each group. The change in the number of tentacles has led to some of the early stages being described as distinct species. Sars first described the medusa (*Cytæis octopunctata*) from specimens with three tentacles in all the groups (=*Rathkea* of Haeckel). Forbes described specimens (*Lizzia octopunctata*) having either two or three tentacles in the perradial groups, and three tentacles in the interradial groups. Forbes regarded these specimens as belonging to the same species as those described by Sars. Haeckel, however, has separated these specimens into two genera: those with two tentacles in the perradial groups are placed in the genus *Margellium*; the others in the genus *Rathkea*.

I have already shown, in the Report on the Medusæ of the Isle of Man, that Forbes was right in regarding his specimens as identical with the medusæ described by Sars as *Cytæis octopunctata*. Garstang has also shown that Haeckel was wrong in separating these medusæ into two distinct genera.

Agassiz (1865) has described a medusa, *Lizzia grata* (=*Margellium gratum*, Haeckel), which has five tentacles in each of the four perradial groups and three tentacles in each of the four interradial groups. From the specimens collected at Valencia, I have every reason for believing that *Lizzia grata* is the adult form of *Margellium octopunctatum*.

The early stages of *Margellium octopunctatum* were fairly abundant in Valencia Harbour at the beginning of April, but decreased in number during May. Most of the specimens taken during April and the early part of May had one to four medusa-buds upon the stomach. About the middle of May specimens were taken with either ova or spermatozoa upon the wall of the stomach. The reproductive cells first begin to appear upon the perradial ridges on the outside wall of the stomach, and as they increase in size they form a mass covering the wall of the stomach. As soon as the reproductive cells begin to appear, the budding of medusæ ceases. The compound basal bulbs of the tentacles show little variation in colour, being usually dark brown or black. One specimen, however, had reddish-brown bulbs.

The specimens taken at Valencia resemble those taken at Port Erin. I have no doubt that they belong to the same species, and as they were taken in a distant locality it may be of interest to record some for comparison with those taken at Port Erin. The following list shows the number of tentacles in each perradial and interradial group of 16 specimens taken at Valencia. It is also arranged to show the increase in the number of tentacles during the growth of the medusa.

$$\begin{array}{l}\text{Perradial}\\ \text{Interradial}\end{array}\ \frac{3333}{1112},\ \frac{3333}{3231},\ \frac{3333}{2222},\ \frac{3333}{2333},\ \frac{3333}{3333},\ \frac{3334}{3333},$$

$$\begin{array}{l}\text{Perradial}\\ \text{Interradial}\end{array}\ \frac{4343}{3333},\ \frac{5334}{3333},\ \frac{5344}{3333},\ \frac{5433}{3333},\ \frac{5444}{3333},\ \frac{4454}{3333},$$

$$\begin{array}{l}\text{Perradial}\\ \text{Interradial}\end{array}\ \frac{5454}{3333},\ \frac{5553}{3333},\ \frac{5554}{3333},\ \frac{5555}{3333}.$$

The above series corresponds very closely with a series given in the Report on the Isle of Man Medusæ.

The umbrella of the earliest stage is about 1 mm. in length, and that of the adult from 3 to 4 mm.

Not only does the medusa increase the number of its tentacles as it grows, but also the number of clusters of nematocysts upon the oral tentacles, which are four in number. Though some of the specimens taken off the Isle of Man possessed the same number of tentacles as *Margellium gratum*, the clusters of nematocysts upon the oral tentacles were fewer in number. Until I had seen an exact similarity in every detail, I did not feel justified in placing *Margellium gratum* as the adult of *Margellium octopunctatum*. At Valencia I specially examined the oral tentacles of every specimen taken, and found a few specimens agreeing with Agassiz's description of *Margellium gratum*, both in the number of marginal tentacles, and in the number of clusters of nematocysts on the oral tentacles. I think this removes all doubt concerning the identity of the two species.

In the Valencia specimens the clusters of nematocysts develop in the following order:—The earliest stage has each oral tentacle terminating in a single cluster of nematocysts. A second cluster appears near the first cluster upon a short stalk; the tentacle then appears bifurcated, each branch terminating in a round cluster of nematocysts. Two more clusters, each on a short stalk, make their appearance, one on each side of the tentacle, about the middle of its length. This was usually the appearance of the oral tentacles in all the large specimens taken at Port Erin and at Plymouth. At Valencia, in a few of the largest specimens, with four or five tentacles in each perradial group, I observed on each oral tentacle a second pair of lateral clusters of nematocysts, below the first pair. One specimen had a fifth cluster on a short stalk situated midway between the two terminal clusters. This agrees with the development of the clusters described by Agassiz in *Margellium gratum*. Another specimen, however, showed a variation in development, by possessing three terminal clusters and only a single pair of lateral clusters.

Allman (1859) has described and figured a Calyptoblastic hydroid, *Laomedea tenuis* [=*Leptoscyphus tenuis*, Hincks (1868)], which he found at Stromness. The hydroid has gonothecæ each containing a medusa. Allman has not given any description of the medusa inside the gonotheca, and from the figure it is impossible to identify it, chiefly on account of its being at a very early stage in development. Allman found inside the jar containing this hydroid a number of young medusæ which he believed to be closely related to the genus *Lizzia*. From the description given of these medusæ I believe they are probably an early stage of *Margellium octopunctatum*. Allman regards these free-swimming medusæ as the medusa of the hydroid in the jar. This observation has never been confirmed, and if it be true, then a case is established in which a Calyptoblastic hydroid produces Anthomedusæ.

Allman does not state that he has seen a single medusa leave the hydroid nor show in any way that the medusa inside the gonotheca resembles the free-swimming *Lizzia*. I do not think that there is sufficient evidence to prove that the medusæ came from the hydroid, and I hesitate to accept the statement until the observations have been confirmed. It is quite possible that the young *Lizzia* entered the jar along with the sea-water.

DISTRIBUTION. America—Massachusetts Bay, *Agassiz*. Norway, *Sars*. France—Wimereux, *Giard*.

Scotland—Shetland Islands, *Forbes*. St. Andrews, *M'Intosh*.

England—Plymouth, *Garstang*; *Allen*. Fowey, *Peach*. Falmouth, *Vallentin*. Isle of Man, *Browne*.

Ireland—Valencia Island, *E. T. B.*

LEPTOMEDUSÆ.

Fam. THAUMANTIDÆ.

THAUMANTIAS HEMISPHÆRICA, Eschscholtz.

The naturalists who studied marine life at the end of the last century and at the beginning of the present one worked under many difficulties which have now passed away, mainly owing to the improvements in lenses and in the advancement of the chemical methods of preservation.

The descriptions and figures of the jelly-fishes given by the pioneers of marine zoology usually lack the details necessary at the present day for the identification of the species.

The marginal sense-organs or marginal vesicles, which require the use of a microscope to show their presence and structure, have been in most cases omitted, and now recent researches show that they are very important organs for the identification of the species.

The early workers on Medusæ apparently did not recognize the fact that Medusæ, like many other animals, pass through various stages of growth and that the early stages are often unlike the adult forms.

This led to the early stages of Medusæ being described as distinct species, which together with the vague descriptions given and inaccurate drawings has led to much confusion.

I do not think that any good is to be obtained by retaining inaccurate descriptions of Medusæ, and by burdening our literature, already overloaded, with long lists of useless synonyms.

Medusa hemisphærica was first described by Gronovius (1760) from the coast of Belgium. Müller (1766) described a medusa, as *M. hemisphærica*, from the coast of Denmark, and in a later publication (1778) placed Gronovius's medusa as a synonym of it. The descriptions and figures given by these authors are too vague and inaccurate for the identification of the species.

Péron and Lesueur (1809) separated the above medusæ into two species—*M. hemisphærica*, Gronovius, and *Oceania danica* (Müller). Fleming (1828) changed the generic name to *Geryonia*, and Eschscholtz (1829) again changed it to *Thaumantias* and united both species under the name of *Thaumantias hemisphærica*. Lesson (1843) has copied from Eschscholtz, without adding any fresh information.

Macartney (1810) described two species of medusæ taken at Herne Bay in 1804. The one he called *Medusa scintillans*, which is described and figured. This is clearly the common protozoon—*Noctiluca miliaris*. For the other he suggested the name *Medusa lucida*, but stated that it may be a variety of *Medusa hemisphærica*, Gronovius. It is not possible to identify Macartney's medusa from his description. In the same paper Macartney described and figured a large *Scyphomedusa* under the name of *Medusa pellucens*. This medusa was taken by Sir Joseph Banks. "On a passage from Madeira to Rio de Janeiro the sea was observed by Sir Joseph

Banks to be unusually luminous, flashing in many parts like lightning. He directed some of the water to be hauled up, in which he discovered . . . . a large species of medusa, to which he gave the name *pellucens*. The *Medusa pellucens* measures about six inches across the crown or umbrella."

This is clearly from the figure and description a Scyphomedusa. Shaw (1812) has copied the figure given by Macartney.

Lesson (1843) has not only given *Thaumantias hemisphærica* as a distinct species, but also *Thaumantias lucida*, Macartney. Amongst the synonyms of the latter Lesson has placed *Medusa scintillans* (=*Noctiluca scintillans*) and *Medusa pellucens* (=Banks's Scyphomedusa), but in the description of the species he only gives Macartney's description of *Medusa lucida*. Haeckel apparently has copied from Lesson, without referring to the original papers, as he has placed as synonyms under *Thaumantias hemisphærica* both *Medusa scintillans* and *Medusa pellucens*.

Forbes (1848) next described *Thaumantias hemisphærica*. It is first, however, important to consider Forbes's views upon the value of sense-organs or marginal vesicles for the identification of the species.

Forbes, in 1841, gave the following advice on the identification of species belonging to the genus *Thaumantias*:—

"1st. The number of tentacula (always a multiple of four).
2nd. The presence, absence, size, and colour of the eyes at their bases.
3rd. The colour of the cross-vessels and proboscis.
4th. The shape of the umbrella.
5th. The shapes of the clubs of the vessels.
6th. The form and lobation of the oral proboscis or peduncle.

"I have mentioned these sources of character in what I conceive to be the order of their respective importance, but all should if possible be noted."

I may here say that Forbes's statement that the tentacles are always a multiple of four is not correct. The multiple system is also adopted by Haeckel, and it leads to the assumption that Medusæ have a most wonderful symmetry. The statement holds good up to thirty-two tentacles, but above that number the tentacles, when carefully counted, show odd as well as even numbers. I found, out of 47 mature specimens of *Obelia lucifera*, only two specimens showing an equal number of tentacles in each of the quadrants, and only nine specimens possessing a number that could be equally divided by four. Twenty-six specimens have an even number of tentacles, and 21 specimens an odd number.

Forbes included in his genus *Thaumantias* several Medusæ which have since been transferred to other genera, viz.:—

Thaumantias pilosella (=*Euchilota pilosella*).
Thaumantias lucifera (=*Obelia lucifera*).
Thaumantias melanops (=*Tiaropsis multicirrata*).

All these have certain characteristic features by which they may be easily recognized. The other fourteen species of *Thaumantias* form a miscellaneous group, which, owing to their vague descriptions, have caused a considerable amount of trouble to recent writers on Medusæ.

Haeckel has divided these species amongst two families—*Thaumantidæ* and *Eucopidæ*—the former characterized by the absence of marginal vesicles, and the latter by the possession of them. Forbes has omitted the vesicles in the descriptions and figures of nearly all his species, and according to his views they were worthless for specific characters. If Forbes had only added these important organs to his drawings, which have been rendered almost useless by their omission, the present confusion would never have arisen. It is clear that Forbes has seen the marginal vesicles in some of the species, as in his monograph (p. 9) he writes:—"I have observed the vibration of the otolites distinctly in more than one species of *Thaumantias*."

After the publication of Forbes's monograph the name of *Thaumantias hemisphærica* appeared on most lists of Medusæ, usually without any description of the medusa.

Since the appearance of Haeckel's monograph the name has gone out of fashion, and *Phialidium variabile* has taken its place. For three years I have searched for *Thaumantias hemisphærica* and the allied species, also without marginal vesicles, but without any success. Every specimen, which has the slightest resemblance to one of Forbes's figures, possesses marginal vesicles.

I may here add that specimens preserved in alcohol are not to be relied upon for the absence of marginal vesicles in the living medusa; the vesicles often shrivel up and the otoliths disappear.

LAODICE CRUCIATA (Forskål).

Haeckel has placed under the name of *Laodice cruciata* no less than twenty-five synonyms, which are divided into two groups—one for the Mediterranean form of *Laodice cruciata*, and the other for the Atlantic form.

The synonyms of the Atlantic form may be divided into two sets, one referring to *Medusa æquorea*, Baster (1759), the other to *Thaumantias pilosella*, Forbes (1848).

Medusa æquorea, Baster (1759); Linnæus (1767).
  Callirhoë basteriana, Péron and Lesueur (1809); Eschscholtz (1829); Blainville (1834).

The original descriptions and figures of this medusa given by Baster, and copied by other writers, without any additional information, appears to me to be too vague for the purpose of identification. The drawings clearly show that the sub-umbrella has been injured, as the stomach and some of the bands of gonads on the radial canals are in a damaged condition. Whatever kind of medusa Baster had under observation, the description and figures appear to be too vague to identify it with any species known to us at the present day.

The second set of synonyms of the Atlantic form refers to *Thaumantias pilosella*, Forbes. This medusa I have taken and have been able to clearly establish its identity. The history of this species is given under *Euchilota pilosella* in these Notes. It possesses marginal vesicles and belongs to the *Eucopidæ*, and has no connection whatever with the genus *Laodice*. Agassiz (1862) first placed *Thaumantias pilosella* in the genus *Laodice* as a synonym of *Laodice stauroglypha.*

The synonyms of the Mediterranean form of *Laodice cruciata* may be divided into three sets. The first set belongs to the synonyms of *Medusa cruciata*, Forskål (1775); the second to *Oceania lineolata*, Péron and Lesueur (1809); and the third set to *Thaumantias mediterranea*, Gegenbaur (1856).

Medusa cruciata, Forskål (1775).
  ? *Aurelia rufescens*, Péron and Lesueur (1809).
  Aurelia crucigera, Risso (1826).
  Medusa crucigera, Eschscholtz (1829).
  Oceania cruciata, Wagner (1841).
  ? *Medusa cacuminata*, Modeer (1791).
  ? *Oceania cacuminata*, Eschscholtz (1829).
  Laodice crucigera, Lesson (1843).
  Thaumantias corollata, Leuckart (1856).

Forskål's description and figures of *Medusa cruciata* do not possess any characteristic features by which they may be identified with any medusa described by recent writers.

Péron gives a vague description of *Aurelia rufescens*, and believes it may be identical with *Medusa cruciata*, Forskål.

Eschscholtz believes that *Medusa cacuminata*, Modeer, may be identical with Forskål's medusa.

Lesson unites all the above synonyms (except *Thaumantias corollata*) under the name of *Laodice crucigera.*

It appears that all the early observers were either describing one species, or if two existed they were not able to distinguish clearly one from the other.

Leuckart describes *Thaumantias corollata* as a new species, and from the description and figure given it seems to be closely related to Forskål's medusa.

The second set of synonyms refers to *Aurelia lineolata*, Péron (1809) and *Dianæa lineolata*, Lamarck (1817).

Péron refers to a "variety of medusa," Borlase (1758). I have looked up Borlase's description and figures: he clearly had under observation a specimen of *Aurelia aurita.*

The third set of synonyms refers to a species called *Thaumantias mediterranea*, described by Gegenbaur in 1856. This species was again described by Haeckel in 1864 under the name of *Cosmetira punctata.* It is quite distinct from *Thaumantias pilosella*, Forbes. It is without marginal vesicles, and possesses both filiform and club-shaped cirri between the tentacles.

I have taken at Valencia three specimens of a medusa which corresponds with the characteristic features of the genus *Laodice* in possessing filiform and club-shaped cirri between the tentacles, and in the absence of marginal vesicles.

The other species of the genus *Laodice* (*L. mediterranea*, Gegenbaur, *L. calcarata*, Agassiz, and *L. ulothrix*, Haeckel) appear to differ so slightly from one another, that I am inclined to regard them as one species.

The species which have been vaguely described by the early naturalists had better remain provisionally under the name of *Laodice cruciata* (Forskål). I think for the present, until more is known about the genus, that *Thaumantias mediterranea* had better be regarded as a distinct species—*Laodice mediterranea* (Gegenbaur),—and *Cosmetira punctata* as a synonym of it.

I do not intend publishing a description of the Valencia *Laodice* until I have collected more specimens, which may then throw some light upon the other species.

Fam. EUCOPIDÆ.

EUCHILOTA PILOSELLA (Forbes). (Plate XVI. figs. 7 & 7*a*.)

Thaumantias pilosella, Forbes (1848); Gosse (1853).
Laodice pilosella, Agassiz (1862).
Laodice stauroglypha, Agassiz (1862).
Laodice cruciata, Garstang (1894).

Forbes has given a fairly complete description of this species, omitting only the marginal vesicles. These important organs were apparently not considered by Forbes of any importance in the specific description of a medusa. Gosse found this medusa very abundant at Ilfracombe, and described it again under the name *Thaumantias pilosella*, with eight marginal vesicles.

At Valencia, during April and May, I found four specimens of a medusa which is identical with the *Thaumantias pilosella* of Forbes and Gosse.

Forbes in his description of the species states:—"The umbrella, which sometimes measures nearly two inches in diameter, but more usually one, or one and a quarter, is hemispheric, and shaped like a watch-glass, but much more convex. It is transparent and smooth, except on the sides towards the margin, where it is as if woolly, being invested with minute epidermic hairs composed of fibrous cells. These, though sufficiently conspicuous, may escape the observer who is not aware of their presence, in consequence of their transparency.

"The margin is fringed by very numerous (100) extensile (but usually borne rather short), pale pinkish tentacula, with bulbous bases. The bulbs are ocellated, with dense crescentic masses of purple pigment-cells. When the margin is much magnified, it is seen to be bordered by a narrow band or thread of fibrous cells, from which the tentacles spring, and between each pair there are six or seven short, fine, secondary tentacles, without ocelli at their bases . .. . The sub-umbrella is depressed, and on its surface run the four radiating vessels, with a long, linear, somewhat clavate ovary, of a bright pink colour, commencing very near the centre, and terminating close to the margin in the course of each. The stomach is very short, but wide, of a rose colour, and has four lanceolate, fimbriated lips, bordered by a compact edging of fibrous cells."

Gosse's description differs slightly from that given by Forbes. His specimens appear to belong to a younger stage, about three-quarters of an inch in diameter, and with about fifty tentacles. No mention, however, is made of the "minute epidermic hairs composed of fibrous cells" near the margin of the umbrella. The following is the description given by Gosse of the marginal vesicles:—"Besides these organs (tentacles), the margin is furnished with others . . . . . They consist of cells, usually more or less globose, each containing one or more spherical bodies of high refracting power. Prof. Forbes has not noticed them in his description of this species; they are, however, large and peculiar: first in shape, being semi-elliptical swellings of the substance of the marginal canal, and secondly in the number of their spherules. The spherules are arranged in a double crescentic row, those which form the middle being generally larger than those at the extremities. The capsules are eight in number, two in each quadrant, nearly equally distributed; but not holding any fixed relation of position to the tentacles."

The specimens which I took at Valencia have not only the cirri on the margin of the ex-umbrella (=" minute epidermic hairs composed of fibrous cells") as described by Forbes, but also the eight adradial marginal vesicles with numerous otoliths, as described by Gosse. The other details of the species agree with the description given by Forbes and Gosse.

An early stage was taken at Valencia on May 4th. Umbrella bell-shaped, 2 mm. in length and width. Four perradial and four interradial tentacles; and also eight adradial bulbs, from which tentacles will develop in a later stage. A few cirri on the margin between the tentacles and bulbs, but none on the edge of the ex-umbrella. Eight marginal vesicles, each with 4 to 6 otoliths.

The basal bulbs of the tentacles and the bulbs without tentacles are alike in coloration. There is a yellowish centre nearly surrounded by a deep purplish band, which does not meet on the inner side of the bulb.

A specimen was taken 15 mm. in width and 11 mm. in length.

Apparently all the large watch-glass shaped medusæ are in their earliest stages bell-shaped, the umbrella being about as long as wide. The umbrella gradually grows broader; the tentacles at the same time increase in number.

A specimen was taken on April 23rd, at Valencia, with the umbrella 20 mm. in diameter and shaped like a deep watch-glass. The stomach short, and mouth with four fimbriated lips. On the margin of the umbrella 28 large tentacles, and between every pair a large bulb, the commencement of another large tentacle.

Between every bulb and tentacle six to ten cirri, very small and colourless. Scattered on the ex-umbrella, just above the margin, are numerous cirri, such as Forbes described.

Eight adradial marginal vesicles, with about twelve otoliths in each. The gonads are upon the four radial canals, extending from the stomach nearly to the margin of the umbrella. The basal bulbs of the tentacles and the large bulbs without tentacles are alike in colour; a yellow centre nearly surrounded by a purplish band.

I sent to Mr. E. J. Allen, at Plymouth, a description of these medusæ taken at Valencia, and asked him to collect specimens for me. He kindly sent me seven specimens, alive, and some more in formaline, on June 28th. They were similar to the specimens taken at Valencia. The marginal vesicles contained a few more otoliths, arranged in some specimens in two rows. The stomach, mouth, and gonads purplish in colour. The tentacle-bulbs were coloured exactly like those of the Valencia specimens. There were cirri upon the ex-umbrella near the margin, and also between the tentacles. Diameter of the umbrella 10 to 15 mm.

During a visit to Plymouth, in 1893, I saw some specimens of a medusa, labelled *Laodice cruciata*, taken by Mr. Garstang. Some of these specimens are now in my collection. They show the cirri on the ex-umbrella near the margin, and agree in other details with the description given by Forbes. The marginal vesicles are not to be seen, as the specimens are in alcohol. I have proved over and over again that the marginal vesicles often shrivel up in spirit-specimens. Therefore, the absence of vesicles in spirit-specimens does not prove their absence in living specimens.

During a visit to Plymouth in September, 1895, I found in the tow-net a very young medusa, which I believe, from the coloration of the tentacle-bulbs, may possibly be the earliest free-swimming stage of *Euchilota pilosella*. (Pl. XVI. figs. 7 & 7*a*.)

Umbrella bell-shaped, about 1 mm. in length and width. Eight marginal vesicles, with a single otolith in seven of them and two otoliths in the other one (the number of otoliths increases with age). Two opposite perradial tentacles, very short, and two opposite perradial bulbs, without tentacles. The basal bulbs of the tentacles are alike in coloration, a yellowish centre with a purplish band; the bulbs without tentacles colourless.

The mouth has four lips, and the stomach extends into the substance of the umbrella, terminating in an apical stalk, which shows that the medusa has not long been liberated either from another medusa or from a hydroid colony, in this case probably from the latter. I placed this medusa in an aquarium; nine days later the apical stalk had disappeared, but the tentacles remained in same condition.

I think there should be no difficulty in identifying *Euchilota pilosella*. The cirri upon the ex-umbrella near the margin and the eight marginal vesicles distinguish it from any other species, *Mitrocomella polydiadema* (Romanes) is very much like *Euchilota pilosella* to the naked eye; but it has sixteen marginal vesicles and no cirri upon the ex-umbrella.

DISTRIBUTION. Scotland—Shetland Islands, *Forbes*.
England—Plymouth, *Garstang*, *Allen*. Falmouth, *Alder*.
Ireland—Valencia Island, *E. T. B.*

EPENTHESIS CYMBALOIDEA, Haeckel.

This is another mysterious medusa which has been handed down to us by the ancient naturalists. Slabber first described it under the name of *Medusa cymbaloidea* in 1775, and Shaw (1789) has copied Slabber's figures and also changed the name to *Medusa campanella*. To judge from the figures given, the medusa appears to be very much like *Thaumantias hemisphærica* (Gronovius) with fewer tentacles. The generative organs occupy the outer half of the radial canals. The medusa was caught by Slabber in the act of swallowing a fish, tail foremost, of which a figure is given. Lamarck (1817) has copied Slabber's description, and Eschscholtz (1829) changed the generic name to *Thaumantias*.

Blainville (1834) has given again Slabber's account of the species and copied his figures, but has left out the wonderful fish.

Haeckel (1879) has placed all these references under the name of *Epenthesis cymbaloidea*, a genus of the Eucopidæ, and characterized by the possession of 16 marginal vesicles and 16 tentacles.

Amongst the synonyms Haeckel has placed *Thaumantias thompsoni*, Forbes, which is also given as a doubtful synonym of *Thaumantias forbesii*, Haeckel (Thaumantidæ, Haeckel). The figure of Slabber's medusa bears no resemblance to Forbes's species, which is more like *Phialidium buskianum* (Gosse). It only requires the addition of the necessary marginal vesicles to make the identification complete. These Haeckel has added.

Eucope gemmigera, Keferstein (1862), is also given as a synonym by Haeckel of *Epenthesis cymbaloidea*. According to Keferstein this medusa has a ciliated medusa-bud upon the stomach. I prefer for the present to regard this medusa as a distinct species. The medusa-bud is not described in detail and the figure shows the external shape only. It may be a young stage of the parasitic *Halcampa*, which often attaches itself to the stomach or the generative organs of medusæ.

Epenthesis cymbaloidea, Haeckel, and its synonyms have no connection whatever with *Phialidium cymbaloideum* (Van Beneden).

PHIALIDIUM VARIABILE, Haeckel.

Under this name Haeckel has united several species which I consider to be quite distinct. He gives no less than 26 references which are divided into two sets, one for the Mediterranean and the other for the Atlantic Ocean.

Just as in the case of *Thaumantias hemisphærica*, the early writers omitted the marginal vesicles, which amongst the Eucopidæ are of the greatest importance for the identification of the species.

Péron and Lesueur (1809) first described two medusæ—*Oceania flavidula* from Nice [= *Dianæa flavidula*, Lamarck (1817); *Phialidium flavidulum*, Haeckel (1877)], and *Oceania phosphorica* from the English Channel [= *Dianæa phosphorica*, Lamarck (1817); *Oceania phosphorica*, Agassiz (1862); *Phialidium phosphoricum*, Haeckel (1877)]. These Haeckel has given as synonyms of *Phialidium variabile*. The original descriptions appear to me to be too vague for the identification of the species, as the marginal vesicles have been omitted.

Two other medusæ are placed amongst the synonyms by Haeckel viz. *Eucope variabilis*, Claus (1864), and *Thaumantias buskiana*, Gosse (1853). They may belong to the same species, but I perfer to keep them apart until their hydroid forms have been recognized, as *Eucope variabilis* belongs to the Mediterranean (Trieste), and *Thaumantias buskiana* to the British Seas.

Thaumantias buskiana I consider a distinct species, and refer to it in this paper under the name of *Phialidium buskianum*.

Claus (1864 and 1881) has given an excellent description with figures of the growth of the medusa *Phialidium* (*Eucope*) *variabile*. It is quite possible that *Geryonia planata*, Will (1844), from Trieste, *Thaumantias dubia*, Kolliöker (1853), from Messina, and *Phialidium viridicans*, Leuckart (1856), from Nice, may be stages in developmeet of *Phialidium variabile* (Claus).

I have recognized as a distinct species *Thaumantias cymbaloides*, Van Beneden (1861). It possesses only eight marginal vesicles, by which it may be easily distinguished from the other species. I refer again to this species under the name of *Phialidium cymbaloideum* (Van Beneden).

I have found another species which apparently has been mixed up with *Phialidium cymbaloideum* (Van Beneden). I cannot find a good description of this medusa by which it may be distinctly recognized from the other species. To prevent confusion I propose to call this species *Phialidium temporarium*. It is very much like *Phialidium ferrugineum*, Haeckel (1864), from the Mediterranean. It may be the same species, but I prefer to keep them apart until the hydroid forms of both have been clearly identified.

According to Hincks (1868) there are four distinct species of hydroids, viz. *Clytia johnstonii*, Alder, *Campanulina acuminata*, Alder, *C. repens*, Allman, and *C. turrita*, Hincks, which liberate medusæ almost identical in form. These, I have but little doubt, will eventually be proved to be connected with medusæ belonging to the genus *Phialidium*. At present the rearing of these young medusæ has not been carried to the stage which is necessary to connect them for a certainty with the free-swimming *Phialidium*.

PHIALIDIUM BUSKIANUM, Gosse. (Plate XVI. figs. 6 & 6*a*.)

During my visit to Plymouth in September 1893 and 1895, I collected many specimens of a medusa in various stages of development. Owing to the ripe state of the ova in some of the specimens, I was able to distinguish the species as *Thaumantias buskiana*, Gosse. It is quite distinct from *Phialidium temporarium* and *Phialidium cymbaloideum*, as the generative organs never extend along the outer half of the radial canals, and are always round or slightly oval in shape.

It may be difficult to distinguish this species in its early stages from *Phialidium temporarium*. I have not yet met with the two species together; the latter appears in the spring and the early part of the summer, and the former in the autumn.

Gosse named this species after Busk (1849), who described a similar medusa (without giving it a specific name) taken in the Solent during the autumn of 1848.

Unfortunately Busk's figures of the medusa are useless for identification. I believe that Busk took specimens of this species and also of other species which he has confused with it.

Gosse was the first to give this species a description by which it may be readily identified. The following is an abstract of the description:—Umbrella when young globose, when older hemispherical or shallow campanulate, from 2 to 6 mm. in diameter, transparent and colourless. The margin of the umbrella fringed with 20–32 tentacles, very slender and extensile, with yellowish basal bulbs. A marginal vesicle between every two tentacles; sometimes two vesicles present, and occasionally a vesicle has two otoliths. Ovaries small, oval, on the radial canals, containing globular ova in various degrees of development. Stomach small and quadrangular. Taken at Ilfracombe in the autumn.

The Plymouth specimens agree with the description given by Gosse.

The species closely resembles *Phialidium variabile* (Claus), from the Mediterranean. I prefer to keep them separate for the present until the hydroid forms have been identified.

It also closely resembles the figure given by Forbes of *Thaumantias thompsoni*, which was taken by Forbes on the coast of Cornwall and in Roundstone Bay on the west coast of Ireland.

Böhm (1878) has described the medusa under the name of *Clytia johnstoni* from Heligoland.

Hartlaub (1894) has recorded *Phialidium variabile* (Claus) (not Haeckel) from Heligoland.

PHIALIDIUM TEMPORARIUM, Browne. (Plate XVII. figs. 4, 5, 6.)

I find it is necessary to give a specific name to one of the commonest medusæ on our coasts. It is probable that Forbes described this species under the name of *Thaumantias hemisphærica*, but as Haeckel has taken *Thaumantias hemisphærica* as the type of the genus *Thaumantias*, and many other naturalists have placed the species upon their lists, it is necessary to retain it. I have already described some specimens of this species under the name of *Phialidium variabile*, Haeckel, in the 'Report on the Isle of Man Medusæ'; but I have since discovered that *Phialidium* *variabile*, Haeckel, consists of several distinct species, one of them being *Phialidium* (*Eucope*) *variabile* (Claus), a species probably identical with *Phialidium buskianum* (Gosse).

Böhm (1878) has given *Campanulina acuminata* as the name of this species, which he has described and figured in the adult stage, taken off Heligoland. Böhm has not reared the medusa from the hydroid, and does not show that the young medusa from the hydroid *Campanulina acuminata* develops into the medusa which he has described under the same name in the adult condition. No doubt the young medusæ from the hydroid *Campanulina acuminata* do develop into one of the species belonging to the genus *Phialidium*. For this reason I have not used Böhm's specific name of the adult medusa, as it may not belong to the hydroid *Campanulina acuminata*.

I give here a description of the various stages of *Phialidium temporarium*:—

1st Stage. Four tentacles. (Plate XVII. fig. 4.)—The earliest free-swimming stage, which I have seen, was taken at Valencia in May 1895. Umbrella bell-shaped, about ¾ mm. in length and width. Four perradial tentacles and four interradial tentacle-bulbs. Eight marginal vesicles with a single otolith in each. Tentacle-bulbs and the basal bulbs of the tentacles yellowish brown. Stomach short; mouth with four short lips. In one specimen the apical stalk, or the prolongation of the stomach into the substance of the umbrella, was still present, indicating that the medusa had not long been liberated from its hydroid. The generative organs form a minute round or oval swelling, one on each radial canal, about halfway down.

2nd Stage. Eight tentacles.—The interradial bulbs belonging to the first stage develop tentacles, and a little later some of the adradial bulbs begin to appear. It may be sometimes difficult to distinguish at this stage this species from *Phialidium cymbaloideum*, as both possess eight marginal vesicles, but in the latter species I have always seen at least two otoliths in all the vesicles. In *Phialidium temporarium* occasionally two otoliths may be present in one vesicle, but never in all the vesicles.

3rd Stage. Sixteen tantacles and 16 *or more marginal vesicles.*—The adradial tentacles appear in no definite order, so that one quadrant sometimes contains more tentacles than another. The marginal vesicles also increase in number, one is always present between every two tentacles, occasionally two may be present. The umbrella grows faster in width than in length, being about 6 to 7 mm. in width and 4 to 5 mm. in length. The generative organs grow downward towards the margin and become oval-shaped. The colour of the generative organs shows slight variations, usually yellowish brown, occasionally reddish brown.

Adult Stage. (Plate XVII. figs. 5 & 6.)—The largest specimen which I have measured was 21 mm. in width and 11 mm. in length, with 38 tentacles. Two or three marginal vesicles between every two tentacles, with a single otolith in each. This specimen was taken off the Isle of Man.

Another specimen, taken at Valencia, measured 20 mm. in width and 11 mm. in length, with 39 tentacles. One to three vesicles between every two tentacles, with a single otolith.

Thirty-nine tentacles is the maximum number which I have counted in one specimen, and I have not seen more than three marginal vesicles between two tentacles. One or two vesicles are usually present between every two tentacles in specimens possessing 30 to 35 tentacles, and one to three vesicles in specimens with more than 35 tentalces. The stomach is short, of a yellowish-brown colour; and mouth with four lips. The generative organs occupy nearly the whole length of the lower or outer half of each radial canal, and terminate very close to the ring-canal. In mature specimens the generative organs hang in folds and are usually of a yellowish-brown colour. I have noticed in some specimens belonging to the intermediate stages that the generative organs have a greenish appearance, and occasionally the stomach and tentacles are greenish too. The greenish colour is not due to a green pigment, but to the reflection of light upon the organs.

Many specimens taken at Valencia were infested with a species of *Cercaria* which lives in the mesoglœa. *Halcampa* usually selected this medusa, and was often seen attached to one of the generative organs, which showed a remarkable decrease in size compared with the others.

PHIALIDIUM CYMBALOIDEUM (Van Beneden). (Plate XVII. figs. 1, 2, & 2*a*.)

Van Beneden first described this medusa in 1866 under the name of *Thaumantias cymbaloides.* I have changed the specific name from the Greek to Latin form, in accordance with the rules on nomenclature. This species has no connection whatever with *Medusa cymbaloidea*, Slabber, and the synonyms connected with it, which Haeckel has placed under the name of *Epenthesis cymbaloidea.*

I first recognized this medusa during my visit to Valencia in 1895, and was able to see many stages in development. As it often occurred along with *Phialidium temporarium*, I was able to compare the different stages.

Van Beneden has not given a figure of the species, but his description is sufficiently good to recognize without doubt its identity with the medusæ taken at Valencia.

1st Stage. Four tentacles. (Plate XVII. fig. 1.)—Umbrella bell-shaped, about $1\frac{1}{2}$ mm. in length and about 1 mm. in width, with thick walls (thicker than in the corresponding stage of *Phialidium temporarium*). Four perradial tentacles, fairly long, and four interradial tentacle-bulbs. The basal bulbs of the tentacles and the tentacle-bulbs of a yellowish or reddish-brown colour. Eight adradial marginal vesicles, each with two or three otoliths. The reproductive organs form a small oval swelling about halfway down each of the four radial canals. In some of the specimens belonging to this stage the stomach is prolonged into the substance of the umbrella. The prolongation or apical stalk disappears in the later stages, but its presence indicates in some species that the medusa has not long been liberated from its hydroid. The mouth has four small lips.

2nd Stage. Eight tentacles.—The interradial tentacle-bulbs belonging to the first stage develop tentacles, and a few adradial tentacle-bulbs begin to appear. The marginal vesicles never exceed eight even in the adult form, but the otoliths show an increase in number. At this stage sometimes four otoliths may be present, but usually two or three. Width of the umbrella about 3 mm. and slightly less in height.

3rd Stage. Sixteen tentacles.—The adradial tentacles appear in no definite order, and when they reach nearly their full size other tentacle-bulbs commence to grow. The generative organs form a long oval patch upon the radial canals. The otoliths in each vesicle vary from two to four. Diameter of the umbrella 4 to 5 mm.

Adult Form. (Plate XVII. fig. 2.)—I place under this head all specimens with more than 16 tentacles. They increase in number until 32 is reached, but this number may not be the maximum, though it is the most I have seen in a specimen. The marginal vesicles always remain eight in number, one of the characteristic features of the species and by which it may be distinguished from *Phialidium temporarium.* The otoliths in the vesicles show considerable variation even in the same individual. Three or four appear to be about the usual number present but sometimes more. One specimen had five to eight otoliths. The umbrella becomes very thick especially at the aboral end. By the thickness of the umbrella I could usually recognize this species in an aquarium when in company with *Phialidium temporarium.*

The generative cells, which in the earliest stage form a small oval patch about halfway down each radial canal, gradually grow downwards or outwards but do not touch the margin. Usually of a yellowish-brown colour.

The largest specimen seen measured 13 mm. in width and 4 mm. in height. During my visit to Plymouth in September 1893 I saw several specimens of this medusa, belonging to the 1st and 2nd stages, and some early stages at Port Erin in May 1894.

According to Haeckel this medusa, possessing only eight marginal vesicles and no cirri, ought to be placed in the genus *Tiaropsis.* But as the medusa is more like the species belonging to *Phialidium* than *Tiaropsis*, I prefer to place it temporarily in the genus *Phialidium* until its hydroid has been found, rather than make a new genus.

EUTIMA INSIGNIS (Keferstein).

Siphonorhynchus insignis, Keferstein (1862).

Entima insignis, Haeckel (1879); Garstang (1894); Browne (1895).

A single specimen taken at Plymouth on 3rd October, 1893.

Umbrella 7 mm. in width and 3½ mm. in length. Stomach about 2 mm. long, situated on a peduncle 7 mm. long. Mouth with four large lips. Four very long perradial tentacles, about 20 mm. in length when fully expanded, with a pair of cirri at the base of each. About 30 marginal bulbs, each with a pair of cirri. Eight adradial marginal vesicles, each with 2–5 otoliths. The gonads are on the lower half of the peduncle along the radial canals. The medusa is perfectly colourless.

Another specimen taken at Plymouth on 7th September, 1895. Umbrella 8 mm. in width and 4 mm. in length. Thirty-nine marginal bulbs, which are not evenly distributed upon the margin of the umbrella; the four quadrants of the umbrella possessing 9, 13, 7, and 10 bulbs. The gonads are just commencing to develop upon the radial canals, close to the stomach. The marginal vesicles with 3–4 otoliths. In other details the specimen resembles the one described above.

DISTRIBUTION.—France, St. Vaast, *Keferstein*.

England—Plymouth, *Garstang*; *E. T. B.* Isle of Man, *Browne*.

SAPHENIA MIRABILIS (Wright). (Plate XVII. fig. 3.)

Goodsirea mirabilis, Wright (1859).

Saphenia mirabilis, Haeckel (1879); Cunningham (1891); Bles (1892); Garstang (1894); Browne (1895).

Cunningham obtained some hundreds of specimens off the Eddystone, at night, on 16th July, 1891. The largest 12 mm. in diameter.

At the end of September 1893 I found two specimens at Plymouth having the umbrella about 6 mm. in diameter, and eight marginal vesicles each with three otoliths. During September 1895 I met with a few more specimens at Plymouth. One specimen 5 mm. in width and 5 mm. in length. Eight marginal vesicles with 1–5 otoliths, but the majority possessed 3 otoliths. Two long opposite, perradial tentacles, with a pair of cirri at the base of each. Thirty-nine marginal bulbs, not evenly distributed between the radial canals; a pair ofcirri usually present on each bulb. Manubrium very long. Medusa colourless.

A very small medusa taken on 16th Sept., 1895, may possibly be the earliest free-swimming stage of *Saphenia* (Plate XVI. fig. 5 and fig. 5 *a*). Umbrella bell-shaped, slightly longer than wide; about ½ mm. in length. Manubrium about one quarter the length of the umbrella-cavity.

The stomach is not on a peduncle, but has a short conical knob at its base extending into the mesoglœa of the umbrella and terminating in a short apical stalk, which does not reach to the ex-umbrella.

On the margin of the umbrella, two opposite, perradial tentacles, with a pair of cirri at the base of each; two opposite, perradial bulbs, without tentacles, one of the bulbs has a short cirrus; and also four interradial and eight adradial bulbs, without cirri. Eight marginal vesicles, with a single otolith, situated close to the perradial canals.

This medusa is clearly a very early stage, not long liberated from a hydroid. The presence of cirri tends to show that it may develop into a medusa like *Saphenia*, or may bud two more tentacles and become like *Eutima*. As it resembles *Saphenia* in its present condition, I have placed it here until the hydroid form is identified.

At the end of May 1895 I found two specimens in Valencia Harbour. The smaller 4 mm. in diameter. As this medusa has been so little described, I give the characteristic points of the largest specimen (Pl. XVII. fig. 3):—Umbrella 9 mm. in width and 5 mm. in length. Manubrium about 10 mm. long. The two opposite, perradial tentacles about 15 mm. in length, when fully expanded; twelve to fifteen marginal bulbs in each quadrant of the umbrella; the tentacles and all the bulbs with cirri. Eight marginal vesicles with 3–5 otoliths. The medusa is completely colourless, except for a delicate pinkish tinge on the stomach and lips.

Distribution. Scotland—Firth of Forth, *Wright*.

England—Plymouth, *Cunningham*; *Bles*; *Garstang*; *E. T. B.* Isle of Man, *Browne*.

Ireland—Valencia Island, *E. T. B.*

Octorchis gegenbauri, Haeckel.

Octorchis gegenbauri, Haeckel (1864) (1879).

A single specimen of this medusa was taken, for the first time in British Seas, at Plymouth on 7th September, 1895. Only two species—*O. gegenbauri* and *O. campanulatus*—are known and are only recorded from the Mediterranean. The Plymouth *Octorchis* does not correspond exactly to the descriptions given by Haeckel of either the above species, but appears to be an intermediate form, a kind of connecting link between the two species. As it is more like *O. gegenbauri*, I have placed it under that name.

Umbrella bell-shaped, 6 mm. in length and 9 mm. in width. Manubrium when fully expanded 12 mm. long. Peduncle quadrangular, about five times as long as the stomach; mouth with four large, crenate lips. Eight tentacles (4 perradial and 4 interradial), about 10 mm. long when expanded, about 2 mm. long when contracted, without cirri at the base. About 60 bulbs, or warts, evenly distributed on the margin of the umbrella, nearly every one with short spiral cirrus. Eight marginal vesicles, adradial, with 6 to 10 otoliths in two rows. On each of the four radial canals, about the middle of the peduncle, there is an oval mass of ova, and also a genital band, probably containing spermatozoa, extending along the radial canals from the base of the peduncle nearly to the margin of the umbrella. Medusa perfectly colourless.

TRACHOMEDUSÆ.

Fam. GERYONIDÆ.

LIRIANTHA APPENDICULATA (Forbes).

Geryonia appendiculata Forbes (1848).
Liriope appendiculata, Gegenbaur (1856) ; Agassiz (1862).
Xanthea appendiculata, Haeckel (1864).
Liriantha appendiculata, Haeckel (1879).

This medusa was exceedingly abundant at Plymouth during the whole of September and the early part of October, 1893. As most of the specimens belonged to the early stages, I was able to trace its development.

First Stage.—Umbrella sub-globose, from 1 to 2 mm. wide, and about as long. Velum very broad. On the margin of the umbrella there are four interradial tentacles, about half the length of the umbrella, and are usually carried in an upright position alongside the ex-umbrella. On the inner side of these tentacles there are rows of nematocysts, which are directed outwards when the tentacle is alongside the umbrella. These tentacles remain throughout life. On the ex-umbrella, about one-third the distance from the margin, are situated four little, perradial, primary tentacles; each consists of a large cluster of nematocysts upon a short stalk. Within the bulb containing the nematocysts there is a fine whip-like tongue, which I have seen occasionally protruded and after moving rapidly about in every direction withdrawn again inside the bulb. These primary tentacles disappear later in life. The characteristic features of this stage are the primary perradial tentacles and the absence of a manubrium.

Second Stage.—During this stage the manubrium commences to grow downwards, a continuation of the edge of the circular opening in the first stage. At the same time four perradial tentacles commence to grow from the margin of the umbrella. They differ considerably from the interradial tentacles, and are not carried in an upright position, but hang down or trail behind the umbrella when the medusa is in motion and can be extended to a considerable length. Each tentacle has numerous rings of nematocysts. The lateral primary tentacles on the umbrella are usually present, but one or two may be absent. Medusæ belonging to this stage may be characterized by possessing four perradial tentacles on the margin of the umbrella, and a short manubrium, not reaching to the velum. Umbrella about 3 mm. in diameter and colourless.

Third Stage.—This is really the commencement of the adult stage, as the gonads begin to develop upon the radial canals. The lateral tentacles disappear and small scars mark their former position upon the ex-umbrella. The manubrium extends slightly beyond the cavity of the umbrella. Umbrella about 4 mm. in diameter. I have divided the early stages into these three divisions, as most of the specimens taken could thus be separated in the process of sorting; but the whole collection formed one continuous series.

The Adult Stage.—Forbes first described the adult form from a few specimens which he obtained at Dartmouth (Aug. 31, 1845), at Portland, and about 15 miles off the Devonshire coast. I have not seen any other records of the capture of this medusa. I do not think it is a native of our seas, but rather an occasional visitor. It was very abundant in 1893, but I did not see a single specimen during my visit to Plymouth in September 1895. Its home may be in the Mediterranean or in the warmer parts of the Atlantic. The description given by Gegenbaur of *Liriantha mucronata* from the Mediterranean corresponds very closely to the British species. I do not intend here to give a complete description of the adult, as it may be easily identified from the description and figures given by Forbes. It possesses the usual eight sense-organs ("Hörbläschen"). The heart-shaped generative organs are nearer the margin than Forbes's figures show them to be. Haeckel places great importance upon the *glossoconus* ("Zungenkegel"), which is the conical termination of the peduncle inside the stomach. He divides the genus *Liriantha* into two subgenera, one with and the other without the *glossoconus*. Forbes's *Liriantha* is placed in the subgenus without the *glossoconus*, as Forbes never described it; but I have seen it in the Plymouth specimens. Unless specially looked for, it may be easily passed over.

Mr. E. J. Allen, in a letter from Plymouth dated 9th January, 1896, informs me that specimens of *Liriantha appendiculata* were taken at Plymouth on 7th and 8th of January. It is very interesting to note the occurrence of this medusa in the middle of winter.

NARCOMEDUSÆ.

Fam. SOLMARIDÆ.

SOLMARIS, sp.?

Two early stages of a medusa belonging to this genus were taken about three miles south of Plymouth on 7th September, 1895. The umbrella of the largest specimen about 2 mm. in diameter, with 15 lappets. There is a brownish sense-organ ("Hörkölbchen") in the centre of each alternate lappet. Fifteen tentacles, one between every two lappets. No genital ring present. Umbrella and tentacles colourless. The other specimen, about 1 mm. in diameter, with 14 tentacles, 14 umbrella-lappets, seven sense-organs, one on each alternate lappet. The figure (pl. xx. fig. 7) given by Haeckel of *Solmaris coronantha* is very much like the appearance of the young medusæ taken at Plymouth.

The medusæ belonging to the genus *Solmaris* are not natives of our cold seas. Most of the species inhabit the tropical seas; three, however, have been found in the Mediterranean, and one (*S. coronantha*) off the Canary Islands.

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EXPLANATION OF THE PLATES.

Plate XVI.

Fig. 1. *Corymorpha nutans*, adult ♀, × 10; p. 463. Valencia, 1895.

Fig. 2. *Dipurena*, sp.?, probably a young stage, × 60; p. 473. Plymouth, 1895.

Fig. 3. *Lar sabellarum* (*Willsia stellata*), 1st stage, × 25; p. 468. Plymouth, 1893.

Fig. 4. *Lar sabellarum* (*Willsia stellata*), 3rd stage, × 15; p. 468. Plymouth, 1893.

Fig. 5. *Saphenia mirabilis* (?), an early stage, × 40; p. 493. Plymouth, 1895.

Fig. 5*a*. Diagram of the margin of the umbrella.

Fig. 6. *Phialidium buskianum*, adult, × 8; p. 488. Plymouth, 1895.

Fig. 6 *a*. Diagram of the margin of the umbrella.

Fig. 7. *Euchilota pilosella* (?), an early stage, × 25; p. 484. Plymouth, 1895.

Fig. 7 *a*. Diagram of the margin of the umbrella.

PLATE XVII.

Fig. 1. *Phialidium cymbaloideum*, earliest free-swimming stage; p. 491. Valencia, 1895.
Fig. 2. *Phialidium cymbaloideum*, adult, × 8; p. 491. Valencia, 1895.
Fig. 2 *a*. Diagram of the margin of the umbrella.
Fig. 3. *Saphenia mirabilis*, an intermediate stage, × 6; p. 493. Valencia, 1895.
Fig. 4. *Phialidium temporarium*, earliest free-swimming stage, × 22; p. 489. Valencia, 1895.
Fig. 5. *Phialidium temporarium*, × 8; p. 489. Valencia, 1895.
Fig. 6. *Phialidium temporarium*, adult, × 6; p. 489. Port Erin, 1894.

3. On some Extinct Fishes of the Teleostean Family *Gonorhynchidæ*. By A. SMITH WOODWARD, F.Z.S.

[Received March 13, 1896.]

(Plate XVIII.)

In his well-known work 'Recherches sur les Ossemens Fossiles' Baron Cuvier describes several fossil remains of fishes from the Upper Eocene gypsum of Montmartre, near Paris, which he briefly discusses with only provisional results and no definite names. Most of these have been redescribed by subsequent observers, who have had additional specimens and more satisfactory materials for comparison; and the systematic position of some of them is now determined with a considerable degree of certainty. One nearly complete specimen, however, which still remains *incertæ sedis*, has not hitherto received the attention it deserves; for it and a closely-allied form from the Eocene marls of Aix-en-Provence seem to belong to a nearly extinct family of Teleosteans (Gonorhynchidæ) which has not previously been known to occur in the European area.

This fossil is first described in the second edition of the work in question (1822), and exhibits remains of all the skeletal parts of a fish about 0·2 m. in length. As Cuvier himself remarks, the disposition of the fins is very suggestive of that in the "Gonorhynque (*Cyprinus gonorrynchus*, Gron.)"; while "the parts of the head which are observable indicate a Cyprinoid with prominent nose, such as the Gonorhynque, the *Cyprinus nasus* [= *Chondrostoma*], or a similar form." The small mouth, extended premaxillæ, and absence of teeth are also noticed.

A more imperfect example, not improbably of the same species, from Montmartre, had previously been described by de Blainville under the name of *Anormurus macrolepidotus*[1]; and its scales were said to be remarkably similar to those of a larger fish made known at the same time from Aix-en-Provence and referred to a new species of *Cyprinus*, namely *C. squamosseus*. The dorsal fin was described as remote and comprising 14 or 15 rays. The jaws appeared to be toothless, and five broad branchiostegal rays could be counted.

In 1844 the so-called *Cyprinus squamosseus* of de Blainville

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[1] Nouv. Dict. d'Hist. Nat. vol. xxvii. (1818), p. 374.